

Unit 2

Integrated Insect-pest and Disease Management in Paddy Crop

INTRODUCTION

Insects-pests and diseases cause a major problem in paddy cultivation. In order to achieve optimum yield, timely and effective control of insects-pests and diseases is essential. Integrated Pest Management (IPM), also known as integrated pest control, is an approach that integrates practices for effective and economic control of insects-pests so as to realise minimal damage to the main crop (in this case, paddy), produce quality grains, and at the same time, protect beneficial insects and micro-environment of the field. IPM integrates different management systems and strategies to achieve effective and economical crop protection output. IPM makes judicious use of resistant germplasm, agrochemicals, and organic and microbial control agents. The main aim of IPM is to minimise crop losses.

Integrated management for insects-pests

Integrated management for insects-pests and diseases involves the following.

- Field sanitation
- Field scouting and light traps

NOTES

- Avoiding excess fertiliser application
- Sowing of crop at appropriate stage
- Eliminating egg masses by trimming the tips of seedlings before transplanting as infections occur from the nursery stage
- Using resistant varieties
- Using repellents like Neem Seed Kernel Extract (NSKE) as the first step
- Application of pesticides at appropriate time

Methods of insect-pest management

Cultural methods

Cultural methods of insect-pest management, primarily, impact the initial pest load and help reduce the pace of spread of an established insect-pest. Some of these practices are as follows.

Crop rotation

It is a farm operation, in which different crops are grown in the same field in successive seasons or years. Crop rotation with non-host crop will help reduce the occurrence of insects-pests and pathogens in the field.

Summer ploughing

Ploughing operation is, usually, carried out during the summer months. Exposing hidden insects-pests and pupa to direct sunlight results in checking and reducing their population.

Sanitation

Keeping the fields clean, and collection and destruction of infected parts, hiding pupa and insects-pests reduce the occurrence of insect-pest attack.

Time of sowing

Sowing the crop at appropriate time reduces the occurrence of insects-pests as the crop escapes the susceptible stage.

Planting density

Dense planting helps suppress the germination and growth of weeds in a field.

Use of fertilisers

High nitrogen application may promote the occurrence of insects–pests, particularly, sucking insects–pests. Use of optimum and balanced nutrients will help reduce insect–pest attack.

Physical and mechanical methods

These measures indiscriminately kill insects–pests hiding or living in the soil or trashes of previous crop. Some of the common physical and mechanical methods followed by farmers are as follows.

- Burning of trash
- Hand picking
- Deep ploughing

Chemical methods

These bring the desired results quickly and are, thus, popular methods of controlling insect–pest infestation. Chemicals can be used to treat seeds and soil. Chemical application is also done on standing crop in the form of foliar sprays. Often, it may be necessary to use different types of insecticide when insects–pests develop resistance against a particular insecticide.

SESSION 1: INSECT–PEST MANAGEMENT IN PADDY**Major insects–pests in a paddy field**

In order to adopt suitable management strategy against insects–pests, it is necessary to first identify them, the nature of damage they can cause to the crop and appropriate measures to check their population and spread.

Table 2.1: Major insects-pests in a paddy field

S. No.	Name of the insects-pests	Damaging symptoms	Control measures
1.	Paddy stem borer <i>Scirpophaga incertulas</i>	- The insect larva makes tunnels in the main shoot, eats up the growing tissue due to which the central shoot is killed, revealing a 'dead heart'. - The panicle is dried, causing 'white ear' to emerge. Upon pulling, the panicle or the affected tiller easily comes out.	As soon as the symptoms appear, apply any one of the following insecticides, taking care to spray directly into the whorl, at the top. <i>Fipronil</i> 5 per cent SC 1000–1500 g/ha, <i>Thiamethoxam</i> 25 per cent WG 100 g/ha, <i>Chlorpyrifos</i> 20 per cent EC 1250 ml/ha. <i>Triazophos</i> 40 per cent EC @ 625–1250 ml/ha. <i>Phosphamidon</i> 40 SL 600 ml/ha
  			
 			
2.	Gall midge <i>Orseolia oryzae</i>	- This small insect (called maggots) at the larval stage feeds at the base of a growing shoot, forming a tube-like gall, resembling an 'onion leaf' or 'silver shoot'. - Serious infestation results in the absence of panicle emergence.	Spray any one of these insecticides. <i>Fipronil</i> 5 per cent SC 1000–1500 g/ha. <i>Thiamethoxam</i> 25 per cent WG 100 g/ha. <i>Chlorpyrifos</i> 20 per cent EC 1250 ml/ha.

3.	Armyworm or swarming caterpillar <i>Spodoptera mauritia</i>	- Larvae cut the seedlings above the ground and eat up all parts of the plant. - Cattle grazed appearance is found in severely infested fields. - The larva feed and move in large numbers from one field to another (Fig. 2.6).	Spray <i>Chlorpyrifos</i> @ 20 per cent EC 1250 ml/ha during late evening.
4.	Leaf folder or leaf roller <i>Cnaphalocrocis mainsails/ Marasmia patnalis</i>	- Larva remain inside the leaves they feed on them and fold the leaves longitudinally. - The leaves may remain green for some time but later become white, and then, may even dry up. - Under heavy infestation, the paddy field appears like a 'scorched field'.	- Avoid excessive nitrogenous fertilisers. - Spray Neem Seed Kernel Extract (NSKE) @ 5 per cent or <i>Carbaryl</i> @ 50 WP 1 Kg/ha as a preventive measure. - As a measure of biological control, use <i>Trichogramma chilonis</i> (egg parasitoids) @ 5 cc (1 lakh egg parasitoid)/ha. Release it thrice on 37, 44 and 51 days after transplanting. - If it does not produce the desired result, use <i>Chlorantraniliprole</i> @ 0.4 per cent G 10 kg/ha for soil treatment or <i>Chlorantraniliprole</i> @ 18.5 per cent @ 200ml/ha, <i>Flubendamide</i> 20 per cent SG @ 125ml/ha, <i>Cartap</i> 50 per cent SP @ 1000 gm/ha.



Fig. 2.6: White and dried leaves



Fig. 2.7: Pupa of leaf folder or leaf roller

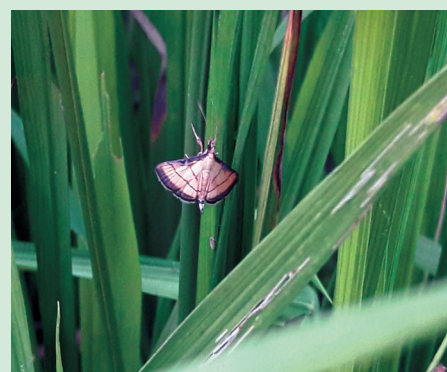


Fig. 2.8: Adult leaf folder or leaf roller

5.	Green leaf hopper <i>Nephotettix virescens</i>	- Leaves become yellowish, starting from the tip to downwards and cause stunted growth. - It acts as a vector to transmit rice tungro virus disease.	- A nursery must not be located near street lamps. - Spray the following insecticides — <i>imidachloprid</i> 17.8 per cent SL 100–140 ml/ha or <i>buprofezin</i> 25 SC @ 500 ml/ha or <i>thiamethoxam</i> 25 per cent WG 100 g/ha.  <i>Fig. 2.9: Green leaf hopper</i>
6.	Brown leaf hopper of paddy <i>Nilaparvata lugens</i>	- Nymphs and adults crowd around the base of the rice plant. - They are sucking in nature and cause heavy damage to the plants. Damaged fields exhibit patches of dry, lodged matured plants, looking like a scorched field, which is called 'hopper burn'. - This pest also transmits viruses, viz., rice ragged stunt, paddy grassy stunt and wilted stunt.	- Avoid excess use of nitrogenous fertiliser for paddy crop. - Minimise water stagnation by intermittent draining. - Employ light traps (at night) and yellow paper or pan traps (day time). - First apply repellents like neem oil @ 15 l/ha of 3 per cent formulation. If it is not effective, apply any of the following. <i>Chlorpyrifos</i> @ 20 EC 1250 ml/ha or <i>Acephate</i> 75 per cent SP 666–1000 g/ha, or <i>pymetrozine</i> 50 per cent WG @ 300 gm/ha - Direct the insecticidal spray towards the base of the paddy plants.
  			
<i>Fig. 2.10: Hopper burn in rice</i> <i>Fig. 2.11: Nymph of brown plant leaf hopper</i> <i>Fig. 2.12: Adult of brown plant leaf hopper</i>			

7.	Rice ear head bug or gundhi bug <i>Leptocorisa acuta</i>	• It sucks the sap from grains in the milk stage. As a result, the grains become chaffy. • The insects emit a foul smell. So, they are called <i>gundhi</i> bugs. • Black spots develop on the grains at the site of feed puncture.	• At infestation, post-flowering ear head stage, spray any of the following twice a day — Neem Seed Kernel Extract 5 per cent @ 25 kg/ha or <i>Imidacloprid</i> 17.8 SL @ 0.6 ml/l water or dusting of <i>Chlorpyrifos</i> 1.5 per cent D 25–30 kg/ha	
----	--	---	---	---

Fig. 2.13: Rice ear head bug (*gundhi* bug)

Rodent management in paddy

Apart from insects–pests, rodents also cause significant crop losses in a paddy field, if not controlled in time. In India, rodents have been estimated to cause 5 to 10 per cent losses in paddy. Rodent droppings and half-eaten grains are typical symptoms of damage caused by them in grain stores.

Managing field rodents

Traps

These are a popular and inexpensive method of rodent control adopted by most farmers in the country.

Smoking of burrows

This operation is used to fill rodent burrows with smoke (Carbon monoxide and Carbon dioxide), which causes suffocation and even death of rodents that damage the crop.

Burrow fumigation

Fumigation by Aluminium phosphide is a widely used and effective measure of rodent control.

Chemical control

Acute rodenticides

Acute rodenticides *viz.*, Zinc phosphide and Barium carbonate act efficiently and effectively in one single dose.

NOTES

Chronic rodenticides

These are multi dose and slow acting rodenticides, for example, *warfarin*, *bromodiolone*, etc.

Practical Exercise

Activity

Identify the different type of insects–pests found in a paddy field.

Material required: insects–pests specimen, box, insect net, writing material, etc.

Procedure

- Visit a nearby paddy field and collect the specimen of different type of insects–pests found there with the help of an insect net.
- Put each insect–pest specimen in separate transparent plastic envelopes and seal them.
- Paste the envelopes in a herbarium file and label each insect–pest.
- Note down the nature of damage caused by the insects–pests and suggest the control measures.

Check Your Progress

A. Fill in the Blanks

1. Growing different crops in the same land in successive seasons or years is termed _____.
2. Ploughing operation carried out during summer months is called _____ ploughing.
3. Dead heart or white ear in paddy crop is caused by _____.
4. Paddy insect, which shows 'scorched field' appearance is called _____.

B. Multiple Choice Questions

1. Tungro virus of rice is transmitted by _____.
(a) stem borer
(b) leaf roller
(c) green leaf hopper
(d) *gundhi* bug
2. The scientific name of paddy stem borer is _____.
(a) *Cnaphalocrocis mainsails*
(b) *Scirpophaga incertulas*
(c) *Nephotettix virescens*
(d) *Nilaparvata lugens*

3. In India, paddy losses due to rodents is about _____ per cent.
 - (a) 1–4
 - (b) 5–10
 - (c) 11–15
 - (d) 16–20
4. *Gundhi* bugs attack rice during the _____ stage.
 - (a) germination
 - (b) flowering
 - (c) milking
 - (d) harvesting

C. Subjective Questions

1. Define Integrated Pest Management. Also, give examples for the same.
2. Describe in brief various methods of insect-pest management.
3. Write some rodent control measures followed in a paddy field.
4. Discuss cultural and chemical methods of insect-pest control adopted in a paddy field.

D. Match the Columns

- | A | B |
|----------------------|------------------------|
| 1. <i>Gundhi</i> bug | (a) Stem borer |
| 2. White ear head | (b) Foul odour |
| 3. Silver shoot | (c) Brown plant hopper |
| 4. Zinc phosphide | (d) Gall midge |
| 5. Stunt virus | (e) Rodent control |

SESSION 2: DISEASE MANAGEMENT IN PADDY

Every rice crop grown is subject to at least mild disease(s) or infection(s). This is caused by fungi, bacteria, viruses, etc. In some instances, the infection becomes severe, leading to heavy crop loss(es).

Methods of disease management

Cultural methods

These methods of disease management prevent and control a disease by reducing initial disease incidence, its pace of spread, etc. Practices that reduce the initial levels of disease inoculums include the following.

Crop rotation

It is the growing of two different or more variety of crop on the same piece of land in successive seasons

NOTES

or years. Rotation with non-host crops helps reduce the occurrence of some disease pathogens. Inclusion of rice and groundnut in crop rotation can control wilt disease caused by *Fusarium oxysporum f. udum*.

Summer ploughing

This operation is carried out during summer months. It results in exposing soil pathogens to heat and sunlight, which helps reduce their population, and hence, diseases caused by them.

Sanitation

Keeping the fields clean, and collection and destruction of infected plant parts after harvest reduce the occurrence of plant diseases.

Time of sowing

Sowing the crop at appropriate time reduces the occurrence of soil-borne pathogens.

Depth of sowing

Seeds sown deep in the soil catch infection(s) early, resulting in pre-emergence damping off.

High seed rate

It creates congenial environment for the occurrence of post-emergence damping off due to overcrowding.

Use of fertilisers

Diseases can be managed by using the recommended dose of fertilisers. For example, high nitrogen dose may suppress brown spots but promote the occurrence of rice blast disease and vice versa.

Green manuring

It helps in improving soil organic matter content and reducing nematode problem.

Physical method

Adoption of physical measures kills all microorganisms living in the soil, irrespective of the fact that they are harmful or useful to the plants. Some of the physical

measures commonly followed in a paddy field include dry heat treatment, hot water treatment and burning.

Biological method

In this method, beneficial and less harmful microorganisms are released to control or suppress pathogenic organisms. For example, *trichoderma* and *gliocladium* are released to control soil-borne pathogens like *rhizoctonia*, *sclerotium*, *sclerotinia* and *fusarium*.

Chemical method

This method of disease management is popular by virtue of the speed with which it brings about the desired results.

Table 2.2: Common diseases in paddy

S. No.	Name of the disease	Damaging symptoms	Control measures
1.	Blast (<i>Pyricularia grisea</i> , <i>pv. oryzae</i>)	The disease infects all aerial parts of a plant, including leaf, neck and node (Fig. 2.14 and 2.15). The name 'blast' is derived from the fact that the entire crop gives a blast or burnt appearance. There are three types of blast. They are as follows. • Leaf blast: The symptoms include brown to dark brown boat or eye-shaped lesions on the leaf surface. • Neck blast: The neck region of panicle becomes black and shrivels, leading to severe crop loss (Fig. 2.15) • Nodal blast: In this case, the nodes of the leaves turn black and break.	• Blast can be effectively controlled by seed treatment and applying <i>Carbendazim</i> 50 WP @ 2 g per litre of water for 1 kg of seeds or <i>Isoprothiolane</i> 1 ml/ha • Fungicides like <i>Carbendazim</i> 50WP @ 500g/ha or <i>Tricyclazole</i> (0.06%) 75 WP @ 500g/ha can be sprayed on the plant to control the spread of the disease at the initial stage itself.



Fig. 2.14: Leaves infected by blast



Fig. 2.15: Neck blast

2.	Bacterial leaf blight <i>(Xanthomonas oryzae pv. oryzae)</i>	• This disease is known as 'seedling wilt' or 'kresek'. Water-soaked to yellowish stripes with wavy margin appear on leaf blades and bacterial liquid comes out of young lesions during morning. • The cut ends of the leaf when soaked in water become turbid due to the secretion of bacterial liquid [Fig. 2.16 (a) and (b)].	• Grow tolerant variety like improved <i>Samba Masuri</i>. • Apply potassium @ 25 kg/ha after draining out water from the field. • Irrigate the field after three to four days of potassium application.  (a) (b) Fig. 2.16 (a) and (b): Bacterial leaf blight
3.	Rice tungro disease <i>Rice tungro virus (RTSV, RTBV)</i>	Plants show stunted growth and reduced tillering. Their leaves become yellow or orangish yellow in colour. Delayed flowering and incomplete exertion of small panicles with sterile or partially filled grains is observed (Fig. 2.17). 	• As a prophylactic measure, spray <i>Thiamethoxam</i> 25 WDG 100g/ha or <i>Imidacloprid</i> 17.8 SL 100ml/ha at 15 and 30 days after transplanting. • To avoid the survival of insect vector, vegetation on the bunds can also be sprayed with insecticides. Fig. 2.17: Rice tungro disease

4. **Sheath blight** (*Rhizoctonia. solani*)
- The disease infests the crop in areas with high relative humidity (above 95 per cent) and moderate temperature (28–32° C). Severe infestation is found in fields with high nitrogen application. Round to irregular shaped necrotic spots are observed on the stem and leaves [Fig. 2.18 (a to d)].
- Two sprays of systemic fungicide like *Carbendazim* 50 WP @ 500g/ ha or *Hexaconazole* 75 per cent WG @ 100mg/ litre is recommended or *Thiophanate* @ 1.5g/litre/ha.
 - The first spray is done at the time of disease appearance and the second after 15 days.



(a)



(b)



(c)



(d)

Fig. 2.18 (a) to (d): Different symptoms of rice sheath blight

5.	Sheath rot <i>(Sarocladium oryzae)</i>	The symptoms appear at the panicle initiation stage. The stem and leaf exhibit irregular spots with dark reddish brown margins and gray centre. Discoloration of the flag leaf sheath occurs and emergence of panicles is inhibited in severe conditions. Infected panicles remain sterile, shrivelled or have partially filled grains (Fig. 2.19 a, b, c and d).	- Seed-borne inoculum can be effectively managed by seed treatment with fungicides like <i>Carbendazim</i> 50 WP @ 3g/kg seed. - Foliar spray with <i>Hexaconazole</i> 75 per cent WG @ 100mg/l is done at an interval of 15 days.
----	--	--	---



Fig. 2.19 (a): Irregular spots on leaf sheath



Fig. 2.19 (b): Discoloration of leaf sheath



Fig. 2.19 (c): Panicles remain within the sheath



Fig. 2.19 (d): Rotting of flag leaf sheath

6.	Brown spot <i>(Helminthosporium oryzae)</i>	This disease is the main reason behind the Bengal famine of 1943, in which millions of people lost their lives due to starvation. The disease affects rice crop in the nursery, as well as, the main field, causing seedling blight. The symptoms include round or oval brown spots of 0.5 to 2.0 mm size, which in severe conditions, merge to form large patches. The seeds are also infected, causing up to 50 per cent reduction in the yield (Fig. 2.20 a, b and c).  Fig. 2.20 (b): Advanced stage of infection	• Treat the seed with <i>Carboxin</i> 10 per cent and <i>Thiram</i> 10 per cent @ 2g/kg seed before sowing. • Apply systemic fungicide, such as <i>Carbendazim</i> 25 per cent @ 1g/litre+ <i>Mancozeb</i> 50 per cent WS @3g/litre or <i>Hexaconazole</i> 75 per cent WG @ 100mg/l. ha • Avoid excess use of nitrogen as it aggravates the disease incidence.  Fig. 2.20 (a): Infected leaf  Fig. 2.20 (c): Circular or oval spots on leaves
7.	False smut <i>(Ustilago ginoidea virens)</i>	The fungal disease appears in grains and the infected grains are transformed into a yellow powdery mass, containing fruiting bodies and spores of the fungus. Mature spores look yellowish green or greenish black [Fig. 2.21 (a) and (b)].  (a)	• Two spray of <i>Propiconazole</i> 25 EC @ 500ml/ha or <i>Copper hydroxide</i> 77 WP @ 1.25 kg/ha at the stage of panicle initiation and 50 per cent at the flowering stage is needed to control the spread of the disease.  (b) Fig. 2.21 (a) and (b): Infested panicle

Practical Exercise

Activity

Identify various diseases that infect paddy crop.

Material required: herbarium file, writing material, personal protective equipment like gloves, gumboots, mask, etc., and samples of plants with infestation

Procedure

- Visit a nearby paddy field and observe symptoms of some diseases appearing on paddy plants.
- Collect the disease samples.
- Put the samples in transparent envelopes and seal the envelopes.
- Make a herbarium file and paste the envelopes, containing the samples.
- Identify the diseases and label them.
- Also, write measures to control the spread of the diseases in paddy plants.
- Make a presentation before the class based on your observations.

Check Your Progress

A. Fill in the Blanks

1. The most common disease in paddy plants caused by bacteria is _____.
2. Round to irregular shaped necrotic spots appear on the stem and leaves of paddy plants in _____ disease.
3. Improved *Samba Masuri* variety of rice is tolerant to _____ disease.
4. Symptoms of false smut can be observed after the emergence of _____.

B. Multiple Choice Questions

1. _____ or kresek symptoms occur in the early stage of growth in rice plant.
 - (a) Bacterial leaf blight
 - (b) Bacterial leaf streak
 - (c) Rice blast
 - (d) False smut
2. Tungro of rice is a _____.
 - (a) fungal disease
 - (b) bacterial disease
 - (c) viral disease
 - (d) None of the above

3. The main reason of the Bengal famine was _____ in paddy.
 - (a) blast disease
 - (b) grassy stunt disease
 - (c) brown spot disease
 - (d) false smut disease
4. High dose of nitrogen application in paddy may suppress _____.
 - (a) brown spot disease
 - (b) blast disease
 - (c) bacterial leaf blight
 - (d) false smut

C. Subjective Questions

1. Describe in brief the major diseases that commonly infest paddy plants.
2. Explain the different methods of disease management in paddy plants.

D. Match the Columns

A	B
1. False smut	(a) Yellowish wavy margin on leaf blades
2. Blast disease	(b) Seed treatment
3. <i>Carbendazim</i>	(c) Affects grains
4. Bacterial leaf blight	(d) Symptoms appear on the leaves, neck and nodes of the leaves